T05D10 – SL Energetics Exam MS

1. B **(4)**
2. C **(4)**
3. A **(5)**
4. B **(5)**
5. A **(5)**
6. C **(6)**
7. B **(5)**
8. A **(5)**
9. C **(5)**
10. D **(6)**
11. C **(5)**
12. A **(6)**
13. B **(7)**
14. C **(5)**
15. A **(6)**
16. A **(5)**
17. C **(5)**
18. B **(5)**
19. B **(5)**
20. D **(7)**

IB Chem SL1			Free Response Section (Paper 02)												Total
Level:	MC	FR	Grade	Possible	3		4		5		6		7		Cutoff	33
Above +6	0%	0%	2	0	50%	1	40%	2.4	30%	3.6	20%	2.2	10%	0.2	9	
Above +5	10%	10%	3	2	80%	1.6	50%	3	40%	4.8	30%	3.3	20%	0.4	13	
Above +4	20%	20%	4	6	90%	1.8	80%	4.8	50%	6	40%	4.4	30%	0.6	18	BELOW
Above +3	35%	30%	5	12	95%	1.9	90%	5.4	80%	9.6	50%	5.5	40%	0.8	23	STANDARD
Above +2	45%	40%	6	11	100%	2	95%	5.7	90%	10.8	80%	8.8	50%	1	28	ABOVE
Above +1	50%	50%	7	2	100%	2	100%	6	95%	11.4	90%	9.9	80%	1.6	31	
Level	**80%**	**80%**	Multiple Choice Section (Paper 01)												Total	
Below -1	90%	90%	Grade	Possible	3		4		5		6		7		Cutoff	20
Below -2	95%	95%	2	0	50%	0	45%	0.9	35%	4.2	20%	0.8	10%	0.2	6	
Below -3	100%	100%	3	0	80%	0	50%	1	45%	5.4	35%	1.4	20%	0.4	8	
Below -4	100%	100%	4	2	90%	0	80%	1.6	50%	6	45%	1.8	35%	0.7	10	BELOW
Below -5	100%	100%	5	12	95%	0	90%	1.8	80%	9.6	50%	2	45%	0.9	14	STANDARD
Below -6	100%	100%	6	4	100%	0	95%	1.9	90%	10.8	80%	3.2	50%	1	17	ABOVE
Below -7	100%	100%	7	2	100%	0	100%	2	95%	11.4	90%	3.6	80%	1.6	19	

21. (a) **(6x1)**BREAK: (Amount of energy required to break bonds of reactants)
[(C-H)412x12] + [(C-C)348x4] + [(C=C)612x1] + [(O=O)496x9) = 11412 kJ mol^{-1}
(5x1)MAKE: (Amount of energy released during bond formation)
[(C=O)743x12] + [(O-H)463x12] = 14472 kJ mol^{-1}

(4x1)ΔH = Σ(Break) – Σ(Make) = -3060 (kJ or kJ mol^{-1}); 3
ECF from above answers.
*Correct answer scores **[3]**.*
*Award **[2]** for (+)3060.*
*If any other units apply **-1(U)**, but only once per paper.*

(b) **(4x1)**<u>exothermic</u> **and** ΔH^{Θ} is negative/energy is released; 1
Apply ECF to sign of answer in part (a).
Do not mark if no answer to (a).

[4]

22. (a) (i) **(3x1)**<u>standard</u> enthalpy (change) of reaction;
(4x1) (temperature) increase;
(5x1)reaction is exothermic/sign of ΔH is negative; 3

(ii) **(6x1)**more (negative);
(7x1)heat given out when gas changes to solid/solid has less enthalpy than gas/*OWTTE*; 2

(iii) **(4x1)**–389 kJ; 1

[6]

23. **(6x1)**$C(s) + 2F_2(g) \rightarrow CF_4(g)$ $\Delta H_1 = -680$ kJ;
(6x1)$4F(g) \rightarrow 2F_2(g)$ $\Delta H_2 = 2(-158)$ kJ;
(6x1)$C(g) \rightarrow C(s)$ $\Delta H_3 = -715$ kJ;
Accept reverse equations with +ΔH values.
$C(g) + 4F(g) \rightarrow CF_4(g)$ $\Delta H = -1711$ kJ,

so average bond enthalpy = $\frac{-1711}{4}$

(6x1)= –428 kJ mol^{-1}; Accept + or – sign 4
*Lots of ways to do this! The correct answer is very different from the value in the Data Booklet, so award **[4]** for final answer with/without sign units not needed, but deduct **[1]** if incorrect units. Accept answer in range of 427 to 428*
If final answer is not correct use following;
*Award **[1]** for evidence of cycle or enthalpy diagram or adding of equations.*
*Award **[1]** for $2F_2$ (g) → 4F(g) 2×158 seen.*
*Award **[1]** for dividing 1711 or other value by 4.*

[4]

24. (i) **(4x1)**the energy needed to break one bond;
(5x1) (in a molecule in the) gaseous state;
(5x1)value averaged using those from similar compounds; 3

(ii) **(6x1)**it is an element/no other species with just a Br-Br bond/*OWTTE;* 1

(iii) **(5x1)** (sum bonds broken =) 412 + 193 = 605;
(5x1) (sum bonds formed =) 276 + 366 = 642;
(5x1)*ΔH*= –37 kJ; 3

*Award **[3]** for correct final answer.*
*Award **[2]** for "+ 37".*
Accept answer based on breaking and making extra C-H bonds.

(iv) **(6x2)**

Enthalpy | $\underline{CH_4 + Br_2}$ / $\underline{CH_3Br + HBr}$; 2

*Award **[1]** for enthalpy label and two horizontal lines, **[1]** for reactants higher than products.*
ECF from sign in (iii), ignore any higher energy level involving atoms.

(v) **(6x1)** (about) the same/similar;
(7x1)same (number and type of) bonds being broken and formed; 2

[11]

25. (a) **(3x1)**Δ*T* = 35.5 – 24.0 = 11.5 (°C/K); 1

(b) **(4x1)**$n = 0.254\ g\ glucose\ x\ \frac{1\ mol\ glucose}{180.18\ g\ glucose}$= 1.41x10^{-3-} mol glucose ; 1

(c) (i) **(5x1)**q_{H2O} = (*mc*Δ*T*) = (75.0 g)(4.184 J g^{-1}C^{-1})(11.5 C) = 3609 J = 3.61 kJ;
(6x1)$\Delta H_c = \frac{3.61\ kJ}{1.41x10^{-3} mol\ glucose}$ = -2560 kJ mol^{-1} 2

Use ECF for values of ΔT and n.

(ii) **(5x1)**Percentage experimental error =$\left|\frac{2803-2560}{2803}\right| x100$ = 8.7 % error; 1

Use ECF for values of ΔH_C.

(d) **(5x1)**enthalpy change of combustion of glucose > TNT, and therefore not important;
(5x1)rate of reaction for TNT is greater than that of glucose, so this is valid;
(5x1)amount of gas generated (in mol) for glucose < than that of TNT
(according to the given equation), so this is also considered valid; 3

[8]